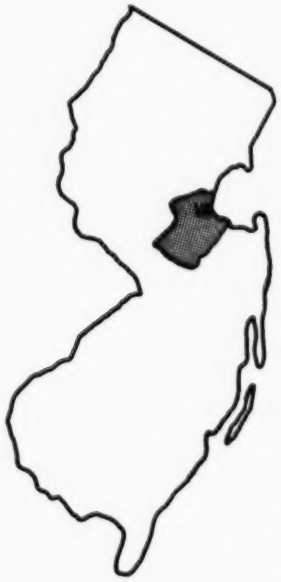
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FLOOD INSURANCE STUDY



BOROUGH OF SAYREVILLE, NEW JERSEY
MIDDLESEX COUNTY



SEPTEMBER 16, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 340276

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
BOROUGH OF SAYREVILLE, NEW JERSEY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Borough of Sayreville, Middlesex County, New Jersey, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Sayreville to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Streams requiring detailed study were selected during an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of the FIA, the New Jersey Division of Water Resources (the study contractor), and local officials. To gather related flood information, contacts were made with the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), and Tetra Tech, Inc. The borough engineer, local developers, and borough residents were also contacted to gain information pertinent to flood problems of the locale. Also, an interim meeting between the community coordinator, representatives of the FIA, the New Jersey Division of Water Resources, and Anderson-Nichols and Company, Inc. was held on January 20, 1977.

On July 18, 1979, results of the study were reviewed with borough officials at the final CCO meeting. Representatives of the study contractor and the FIA, presented the preliminary report, flood boundary and floodway limits, and insurance zone designations to community officials and residents. Comments from the community were subsequently received, reviewed and incorporated into the report as appropriate.

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were prepared by the New Jersey Department of Environmental Protection, Division of Water Resources, Bureau of Flood Plain Management, for the Federal Insurance Administration, under Contract No. H-3855. This work, which was completed in June 1977, covered all significant flooding sources in the Borough of Sayreville. The report was prepared by Anderson-Nichols and Company, Inc., under subcontract to the New Jersey Department of Environmental Protection, Division of Water Resources, Bureau of Flood Plain Management. Survey and topographic data were supplied by GEOD Aerial Mapping, Inc. under subcontract with Anderson-Nichols and Company, Inc.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Sayreville, Middlesex County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

The areas to be studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through June 1982. Flooding within the borough boundaries caused by the overflow of the Raritan and South Rivers; Cheesequake, Mellins and Crossway Creeks; and Tennents Brook was studied in detail. These areas of the borough were considered to be sufficiently flood prone to warrant a Flood Insurance Study. The Raritan River, the South River and Cheesequake and Mellins Creeks were studied in detail between the borough boundaries, while Crossway Creek was studied from its mouth to immediately downstream of the Bordentown-Amboy Turnpike. Tennents Brook was studied from its junction with South River to the borough boundary. The Raritan Bay was also studied by detailed methods.

2.2 Community Description

The Borough of Sayreville, a suburban community of approximately 18.7 square miles, is located on the Atlantic coastal plain of central New Jersey about halfway between Trenton, New Jersey and New York City, New York. It is in the northeastern part of Middlesex County. Sayreville is bordered by the Cities of South Amboy and Perth Amboy and the Raritan Bay on the east, the Townships of Woodbridge and Edison on the north, the Borough of South River and the Township of East Brunswick on the west, and the Borough of

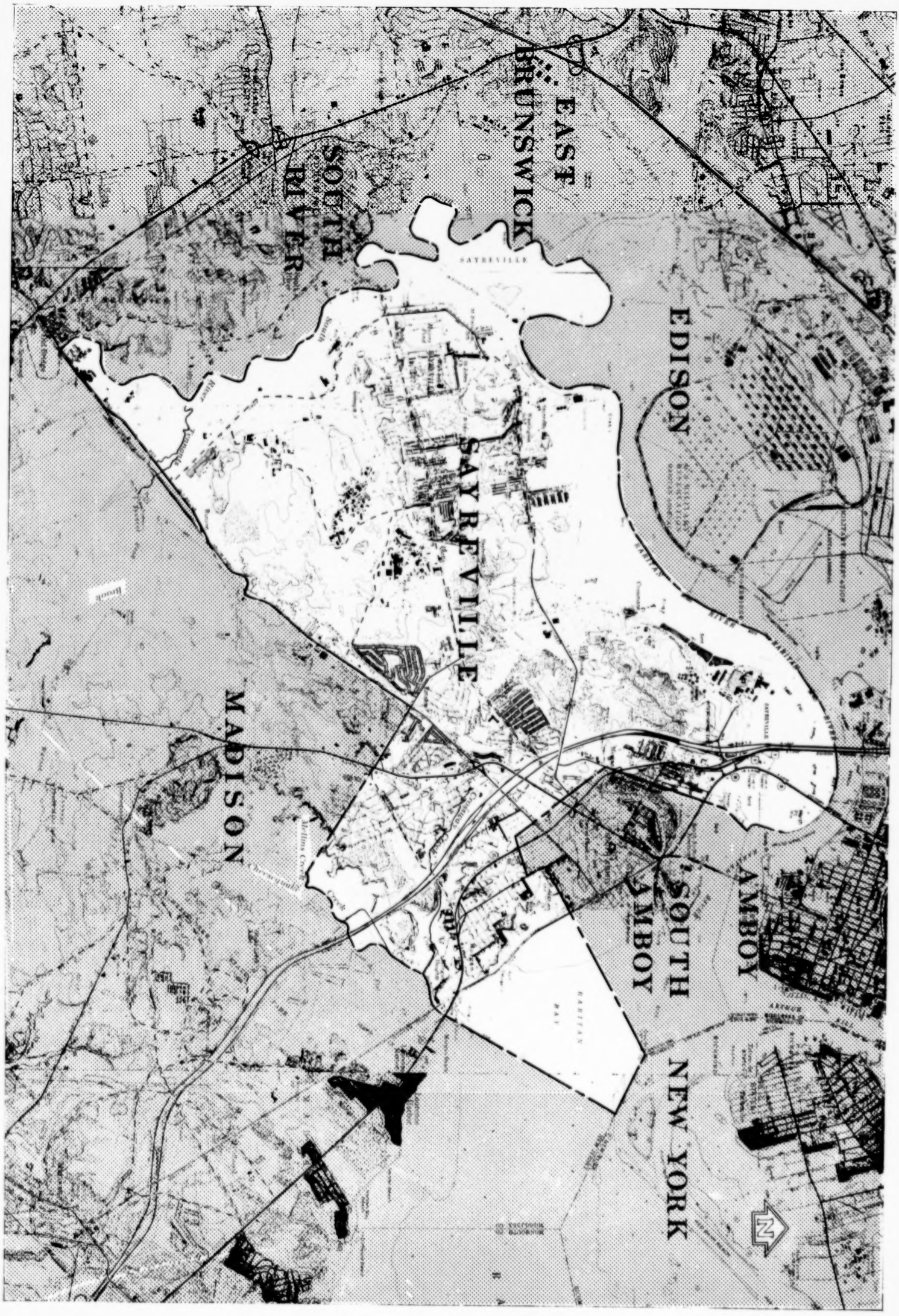


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

APPROXIMATE SCALE
4000 0 4000 8000 12000 FEET

VICINITY MAP

Madison to the south. The 1970 population was 32,508, yielding a population density of 1,700 people per square mile. Data from the 1970 census of population indicates a population increase of 44 percent over the past 10 years.

The lower Raritan River area, where Sayreville is located, was first inhabited by the Raritang Indians. This fertile lowland furnished an abundance of maize, beans, and other foodstuffs and today still provides agricultural commodities to the markets of the east coast. The area also was a main route of trade between Indian tribes.

Like many villages in New Jersey, Sayreville played an important role in colonial America. Historically, the area has always been a major crossroads for trade and travel. Before the era of the railroad, travel between New York and Philadelphia through Sayreville increased at such a rapid pace that 32 stagecoaches were frequently run each day. During this period, an express line carrying special messages between Washington and New York through Sayreville brought an increase in trade and commerce to the borough. Today, Sayreville encompasses a number of major traffic arteries which have become an inducement for commercial and residential growth in the area.

Because of Sayreville's unique location, industry has grown and the borough boasts a variety of manufacturing concerns. Besides several metal- and chemical-related industries, Sayreville also supports several garment manufacturers and a large baking company.

The principal streams in the borough are the Raritan and South Rivers. The Raritan River flows from the confluence of the North and South Branch Raritan Rivers southeasterly to its mouth at Raritan Bay. The Raritan River basin encompasses 1,100 square miles of drainage area and 30 major streams. The South River, which flows northerly from the confluence of Manalapan and Matchaponix Brooks, joins the Raritan to form a large swamp. In this swamp area, the Washington Canal carries most of the normal discharge of the South River. The South River has a watershed of 132 square miles and drains the southeastern portion of Middlesex County. Three of the South River's tributaries are Tennents Brook, Deep Run, and Iresick Brook.

Along the Raritan, there are a number of industrial sites immediately adjacent to the river. There is also some coastal plain development eastward of Conrail in the vicinity of Augusta Street. On the east

bank of the South River, the more extensive development immediately adjacent to the flood plain is in the vicinity of the Veteran Memorial Bridge and MacArthur Road.

The borough lies in that portion of New Jersey which is a coastal plain that rises from sea level to approximately 150 feet. The soils are generally unconsolidated sediments, dating from the Cretaceous Period. These sediments are subdivided into several formations which alternate from water-bearing sands to impermeable layers of clay. As such, these flat sandy soils have a tendency to reduce runoff rates as reflected in the topography by swamp-like areas.

The climate of the region is continental in nature. The winter climate is controlled by polar continental air masses and the summer climate is controlled by tropical air masses moving over the United States from the Gulf of Mexico. Average seasonal temperatures range from 31.5 degrees Fahrenheit (°F) in January to 77.5°F in July, with extremes of -16°F and 106°F. The average annual precipitation is 45.2 inches.

2.3 Principal Flood Problems

The history of flooding in Sayreville indicates that flooding of varied origin may be experienced in any season of the year since New Jersey lies within the major storm tracks of North America. Flooding in Sayreville in the past has been less frequent in the winter months, with the more extensive floods occurring during the late summer and fall. These floods have been associated with tropical disturbances moving northward along the Atlantic Coast. Flooding from coastal storms may be further magnified by abnormally high tides.

The recorded gage history of flooding in the area began in 1903 for the Raritan River and in 1939 for the South River. Since then, a number of major and minor floods have been experienced as indicated by peak stages and discharges recorded at the gage on the Raritan River at Calco Dam (USGS gage no. 01403060) and the gage on the South River at Old Bridge (USGS gage no. 01405500). The maximum recorded discharges for the gages are 46,100 cubic feet per second (cfs) at Calco Dam, which occurred in August 1971; and 4,250 cfs at Old Bridge, which occurred on September 15, 1944.

Two of the more recent floods in Middlesex County were caused by Hurricane Doria in August 1971 and by a prolonged period of heavy rains in September 1975. Hurricane Doria produced such extensive

damage that the President declared New Jersey a natural disaster area. The 1975 flooding was produced from the combination of a tropical storm system arriving immediately following a storm which had saturated the ground. Although flooding was experienced throughout Middlesex County, the daily discharges recorded at the South River gage during this 1975 flood were not the maximum for the year.

The Borough of Sayreville has experienced flooding along the Raritan and South Rivers, with the more serious flooding contained in the vicinity of the Bordentown-Amboy Turnpike near Robert Street. At times, the severity of this flooding has made it necessary to evacuate residents by boat. Localized flooding has occurred in other areas, but this has generally been caused by insufficient drainage and was considered in this study.

2.4 Flood Protection Measures

The borough has no formal structural measures designed specifically for flood protection, but flows on the Raritan River are regulated by the Spruce Run and Round Valley reservoirs. While there are a number of dams within the South River basin, they were not designed with capacities for flood control. A tidal dam has been proposed on the Raritan River at Crab Island which would alleviate flooding along the South River. Throughout the borough, tidal influences are experienced. Unless gaged or sufficiently pumped, storm-drainage systems will not be able to operate efficiently during periods of abnormally high tides. The tides may produce localized flooding in low-lying areas. A series of levees has been constructed between Garden State Parkway and Main Street, near the Raritan River. The levees are not overtopped by the 500-year flood. Levees downstream of Main Street are overtopped by the 100-year flood.

In an effort to minimize flood damages, the Division of Water Resources of the New Jersey Department of Environmental Protection, has adopted rules, regulations, and minimum standards concerning development and use of land within the floodway. The acquisition by the borough of land for open-space application is a potential nonstructural measure for mitigating future flood damage. In addition, one of the goals of the National Weather Service is to provide municipalities with an early warning of expected flooding, particularly in the case of hurricanes.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals

of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the flooding sources.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships and the peak tidal elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

For the detailed-study area, consideration was given to both riverine and tidal flooding. The Borough of Sayreville is subject to continental and maritime storms of tropical or extra-tropical origin, resulting in riverine and tidal flooding. In tidal areas, flooding produced by maritime storms may be magnified or produced just from tidal swells created as a result of the storm path over the open ocean. Although the hurricane is the more publicized storm, northeasters can produce tidal flood damages equaling those of a hurricane. The duration of a hurricane is relatively short and is usually measured in hours while the duration of a northeaster is usually measured in days. This longer duration increases the probability of an extreme high tide occurring while the storm is at its peak. Tidal flood heights from these disturbances are greatly influenced by the angle of storm approach into bays and inlets where the topography, such as shoreline meander or undulation, becomes a factor and causes an increase in the tidal height. The continental storm does not create this tidal situation, and flooding is produced from increased runoff as the result of storm duration and intensity in combination with soil conditions and topography.

To calculate the riverine flood heights of the streams studied in detail, flows were based on stream gage records. Values for the 10-, 50-, 100-, and 500-year peak discharges were calculated at the gages using a log-Pearson Type III analysis of anual peak flow data and the natural gage skew (Reference 1). Flows calculated for the gages located on the Raritan River at Calco Dam and on the South River at Old Bridge were transposed to specific locations according to the standard drainage area-discharge formula:

$$\left[\frac{Q_1}{Q_2}\right] = \left[\frac{A_1}{A_2}\right]^T$$

where Q_1 is the discharge at a specific location and A_1 is the drainage area at that point and Q_2 is the discharge at the gage and A_2 is the drainage area at the gage, with T being the transfer exponent.

For the Raritan River, a value of 0.8 was used for T which corresponds to previous studies for this reach of the river (Reference 2). For the South River, a value of 0.5 was considered to be more representative.

On streams where gage data were not available, stream peak discharges for the selected frequencies were calculated by two methods. For areas with drainage areas of 1 square mile or more, discharges were calculated using regional relationships developed by Stephen J. Stankowski (Reference 3). These relationships were developed through a statistical regression analysis of data collected at over 100 gages across the State of New Jersey. This analysis accounts for urban development as well as natural retention created by lakes and swamps. The rational method was utilized for areas where the drainage area was less than 1 square mile.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

Flooding along the major streams also results from tidal action from the Raritan Bay. This necessitated the determination of whether the governing influence for inundation would result from riverine flow or tidal flow. For floods of each recurrence interval, riverine and tidal flood heights are graphically compared and only the higher elevation is presented on the profiles contained herein.

The Raritan Bay tidal flood heights, as incorporated in this report, are of recurrence intervals of 10, 50, 100, and 500 years and were obtained from Tetra Tech, Inc. These flood heights are the result of a recent tidal analysis involving a computer model of the east coast of the United States to produce more consistent results (Reference 4). These tides are primarily based on a still water flood height as measured by tide gages (Reference 3). Such tide gages are located at Perth Amboy and Sandy Hook, which have a combined period of record from 1935 to 1975. In general, this still water height estimates a static condition of the tide elevation and storm surge, but does not account for wave action.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
RARITAN RIVER					
At downstream corporate limits	1,093	43,600	54,170	62,090	80,590
At Washington Canal	1,072	42,820	53,210	60,990	79,160
SOUTH RIVER					
At downstream corporate limits	132	3,900	6,010	7,050	9,650
Upstream of Washington Canal	130	3,875	5,965	6,995	9,580
Downstream of confluence with Tennents Brook	125	3,785	5,830	6,835	9,360
Upstream of confluence with Tennents Brook	114	3,615	5,575	6,540	8,955
Upstream of confluence with Deep Run	97	3,345	5,145	6,035	8,265
At upstream corporate limits	97	3,345	5,145	6,035	8,265
CHEESEQUAKE-MELLINS CREEKS					
At downstream corporate limits	7.4	165	280	345	500
Downstream of confluence with Crossway Creek	5.7	155	265	320	470
Upstream of confluence with Crossway Creek	3.8	75	135	165	250
Downstream of Garden State Parkway	3.6	65	120	150	230
Downstream of confluence with Mellins Creek	3.4	60	115	140	220
At mouth of Mellins Creek	0.9	45	95	130	160
At upstream corporate limits	0.7	40	80	110	135
CROSSWAY CREEK					
At mouth (junction of Cheesequake Creek)	1.9	425	685	840	1,130
Downstream of Garden State Parkway	1.0	340	545	670	950
Upstream of Garden State Parkway	0.4	200	320	400	500
Approximately 880 feet upstream of Frank Avenue culvert	0.1	20	55	90	130

Tidal conditions are extremely transitory and peak tide levels are maintained for relatively short time periods. During the course of the tidal base flood cycle (100-year flood), the gradual increase in the water level would create low flow conditions through the bridges on the Raritan River, and pressure and weir flow for the bridges along the South River. The volume of water passed by these bridges over the course of the tidal cycle is considered to be sufficient to fill that area adjacent to the stream up to 12.1 feet. This elevation was compared with flood elevations calculated by the riverine backwater analysis. The base flood tidal influences from the Raritan Bay were found to extend through all stream reaches for those studied in detail except for Crossway Creek. Tides from the Raritan Bay influence Crossway Creek downstream of Ernston Road.

All of the flooding sources were partially or entirely inundated by peak tidal flood elevations. These elevations were determined from procedures described in the Coastal Flooding Handbook (Reference 4). A summary of the computed surge values that affect the Borough of Sayreville is shown in Table 2, "Summary of Elevations."

TABLE 2 - SUMMARY OF ELEVATIONS

FLOODING SOURCE AND LOCATION	PEAK ELEVATIONS (FEET)			
	10-YEAR	50-YEAR	100-YEAR	500-YEAR
RARITAN BAY				
Raritan River	7.4	10.8	12.1	15.5
South River	7.4	10.8	12.1	15.5
Cheesequake Creek	7.4	10.8	12.1	15.5
Mellins Creek	7.4	10.8	12.1	15.5
Crossway Creek	7.4	10.8	12.1	15.5
Tennents Brook	7.4	10.8	12.1	15.5

The severity of a tidal flood is difficult to forecast since it is dependent on a number of related factors. Tidal heights from these maritime storms result from the combined effects of barometric pressure, wind and subsequent wave action, storm path and its resulting surge, and the tide height at the time of the storm's arrival. For a given storm in a specific location, any single factor could become the controlling cause of a tidal flood.

Over the ocean, these storms create rises in the ocean surface which are known as surges, and in northern latitudes may travel at a rate of 30 to 50 miles per hour. On the open ocean, the more intense storms produce surges which seldom exceed 3 feet and are comprised

of a fault wave approximately 100 miles long. This surge phenomenon is generally caused by the force of winds circulating in a counter-clockwise direction around the storm center, and by the low barometric pressure associated with the storm center. As the storm surge moves into the shoal waters over the continental shelf, its movement is somewhat impeded causing height increases of 6 to 10 feet above normal tide elevations.

3.2 Hydraulic Analysis

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

To insure consistency, a continuous backwater analysis starting at the mouth of the Raritan River was performed for the South River, Raritan River and Tennents Brook. For Cheesequake Creek, Mellins Creek and Crossway Creek the origin of study is located approximately 1,120 feet downstream of State Route 35 along Cheesequake Creek. The COE HEC-2 step-backwater computer program enabled the computation of water-surface elevations for floods of the selected recurrence intervals (Reference 5).

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

Riverine flood elevations for the 10-, 50-, 100-, and 500-year events were calculated using the Raritan Bay tidal elevation of 5.7 feet as a starting elevation at the two origins of study. The calculated Raritan River flood elevations at the confluence of the South River were used as starting water-surface elevations for the backwater analysis of the South River.

Along the detailed-study reaches of the streams, an analysis of hydraulic characteristics was conducted to establish flood elevations for the selected recurrence intervals. Cross sections for the backwater analysis were taken at appropriate locations to compute the significance of natural and man-made obstructions upon flood flows. The valley portion of these cross sections was obtained photogrammetrically, while the below-water portion was determined by actual

field surveys conducted by GEOD Aerial Mapping, Inc. (Reference 6). Where possible, bridge and dam plans were utilized, and where plans were not available, all significant hydraulic features of structures were measured in the field.

Roughness coefficients (Manning's "n" values) for reaches of detailed study streams were determined by field inspection at the selected cross-section locations. For the Raritan River, the channel "n" value was 0.035 and the overbank "n" values ranged from 0.060 to 0.090. For the South River, the channel "n" values ranged from 0.035 to 0.040 and the overbank "n" values ranged from 0.060 to 0.090. For Mellin and Cheesequake Creeks, the channel "n" value was 0.030 and the overbank "n" values ranged from 0.040 to 0.065. For Crossway Creek, the channel "n" values ranged from 0.030 to 0.035 and the overbank "n" values ranged from 0.050 and 0.080. For Tennents Brook, the channel "n" value was 0.060 and the overbank "n" value was 0.030.

On undeveloped reaches, or on long reaches between structures, sections were located at regular intervals and at changes in valley configuration. At structures, to determine their ability to pass flood flows, cross sections were taken at close intervals up- and downstream and used in conjunction with the significant hydraulic features of the structure.

At some locations along detailed study streams, hydraulic conditions may create a situation of supercritical flow. Because of the inherent instability of such a condition, an assumption of critical flow was adopted for the backwater analyses of this study.

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if the hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATION

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (Reference 6). For the tidal portion of the study, the 100- and 500-year boundaries were delineated using topographic maps of the study area at a scale of 1:2,400 with a contour interval of 5 feet (Reference 6). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown. Owing to limitations of the map scale, such areas are not shown.

For the riverine portion of the study, the boundaries of the 100-and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may be above the flood elevations and, therefore, may not be subject to flooding and owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot which is the criteria used for this study. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study are based on riverine flows, and were determined using Methods 1 and 4 of the Encroachment Option of the COE HEC-2 computer program (Reference 7). The floodway limits are based on an equal conveyance reduction of the overbanks that produces no more than a 0.2-foot water-surface rise at a given cross-section (Method 4). To insure hydraulic continuity within the study reaches, these limits were tested through Method 1, which is a continuous general encroachment along the watercourse. At each cross section, if maximums were exceeded, the encroachments were adjusted so that the water-surface did not rise above the 0.2 foot limit at any location in the study reach. Because of the effect of downstream encroachments on upstream water-surface elevations, there may be cross sections where only minimal encroachment is permitted. This effect imposes an additional constraint on flood plain encroachments and results in a water-surface increase of less than 0.2 foot. Encroachments were made at natural valley sections, and not onto roadways at bridges or along the crest of dams. No encroachments were permitted at sections having pre-floodway conditions that exceeded the limits. The results of these floodway width determinations for each stream studied in detail are listed in Table 3.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "With Floodway" elevations presented in Table 3 for certain downstream cross sections of all the detailed study streams are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2. Portions of the floodway widths on the Raritan River, the South River, and Cheesequake Creek are located outside the corporate limits of the Borough of Sayreville.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT[3] FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Raritan River								
A	4,770	2570/1200	54,310	1.6	12.1	5.8	6.0	0.2
B	8,400	1810/ 910	33,480	1.8	12.1	5.8	6.0	0.2
C	8,850	1860/ 940	34,600	1.8	12.1	5.8	6.0	0.2
D	10,980	2110/1020	33,860	1.8	12.1	5.9	6.1	0.2
E	11,740	1980/1070	33,950	1.8	12.1	6.0	6.2	0.2
F	14,740	1870/930	39,420	1.6	12.1	6.1	6.3	0.2
G	21,270	2840/1165	39,130	1.6	12.1	6.3	6.5	0.2
H	26,240	2430/1060	26,410	2.4	12.1	6.6	6.8	0.2
I	33,860	5700/ 270	29,890	2.0	12.1	7.6	7.8	0.2
South River								
A	38,000	3760/3050	16,150	0.4	12.1	8.6	8.8	0.2
B	39,840	3485/2085	22,210	0.3	12.1	8.6	8.8	0.2
C	45,270	2585/ 300	11,920	0.6	12.1	8.7	8.9	0.2
D	45,490	390/ 235	6,070	1.2	12.1	8.7	8.9	0.2
E	45,840	405/ 185	7,220	1.0	12.1	8.7	8.9	0.2
F	48,050	520/ 220	7,300	1.0	12.1	8.8	9.0	0.2
G	48,160	515/ 210	6,400	1.1	12.1	8.8	9.0	0.2
H	49,790	1155/ 315	8,930	0.8	12.1	8.8	9.0	0.2

[1]Feet above mouth of Raritan River
[2]Width/width within corporate limits
[3]Elevations computed without consideration of tidal backwater effects from Raritan Bay

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

FLOODWAY DATA

RARITAN RIVER AND SOUTH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT [4] FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
South River (continued)								
I	53,010[1]	370/ 195[3]	4,980	1.4	12.1	8.9	9.1	0.2
J	55,700[1]	430/ 255[3]	6,000	1.1	12.1	8.9	9.1	0.2
K	60,040[1]	685/ 340[3]	6,000	1.1	12.1	9.0	9.2	0.2
L	61,870[1]	315/ 155[3]	4,420	1.4	12.1	9.1	9.3	0.2
M	64,910[1]	190/ 90[3]	2,480	2.4	12.1	9.2	9.4	0.2
Cheesequake Creek								
A	1,035[2]	205/ 80[3]	2,775	0.1	12.1	5.7	5.9	0.2
B	4,565[2]	210/ 110[3]	2,535	0.1	12.1	5.7	5.9	0.2
Mellins Creek								
A	6,340[2]	130	1,570	0.1	12.1	5.7	5.9	0.2
B	6,640[2]	190	1,730	0.1	12.1	5.7	5.9	0.2
C	9,080[2]	20	180	0.7	12.1	5.7	5.9	0.2

[1]Feet above mouth of Raritan River
[2]Feet above origin of study
[3]Width/width within corporate limits
[4]Elevations computed without consideration of tidal backwater effects from Raritan Bay

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

FLOODWAY DATA

SOUTH RIVER, CHEESEQUAKE CREEK AND MELLINS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Tennents Brook								
A	58,680[1]	550	3,640	0.3	12.1	8.9[3]	9.1	0.2
B	60,340[1]	580	3,260	0.3	12.1	8.9[3]	9.1	0.2
C	62,250[1]	370	1,890	0.6	12.1	8.9[3]	9.1	0.2
Crossway Creek								
A	3,600[2]	930	2,890	0.3	12.1	5.7[3]	5.9	0.2
B	5,470[2]	250	440	1.9	12.1	5.7[3]	5.9	0.2
C	7,585[2]	250	460	1.8	12.3	12.3	12.4	0.1
D	7,731[2]	70	474	1.8	14.0	14.0	14.0	0.0
E	8,435[2]	40	96	8.8	14.1	14.1	14.2	0.1
F	8,990[2]	30	157	4.3	16.6	16.6	16.8	0.2
G	11,030[2]	20	77	5.2	30.6	30.6	30.6	0.0
H	11,450[2]	20	43	9.3	35.6	35.6	35.6	0.0
I	12,160[2]	35	118	2.5	38.7	38.7	38.7	0.0
J	12,430[2]	30	35	8.4	43.9	43.9	43.9	0.0
K	12,705[2]	20	110	2.7	55.1	55.1	55.1	0.0
L	13,420[2]	30	20	4.5	59.2	59.2	59.2	0.0

[1]Feet above mouth of Raritan River
[2]Feet above origin of study
[3]Elevations computed without consideration of tidal backwater effects from Raritan Bay

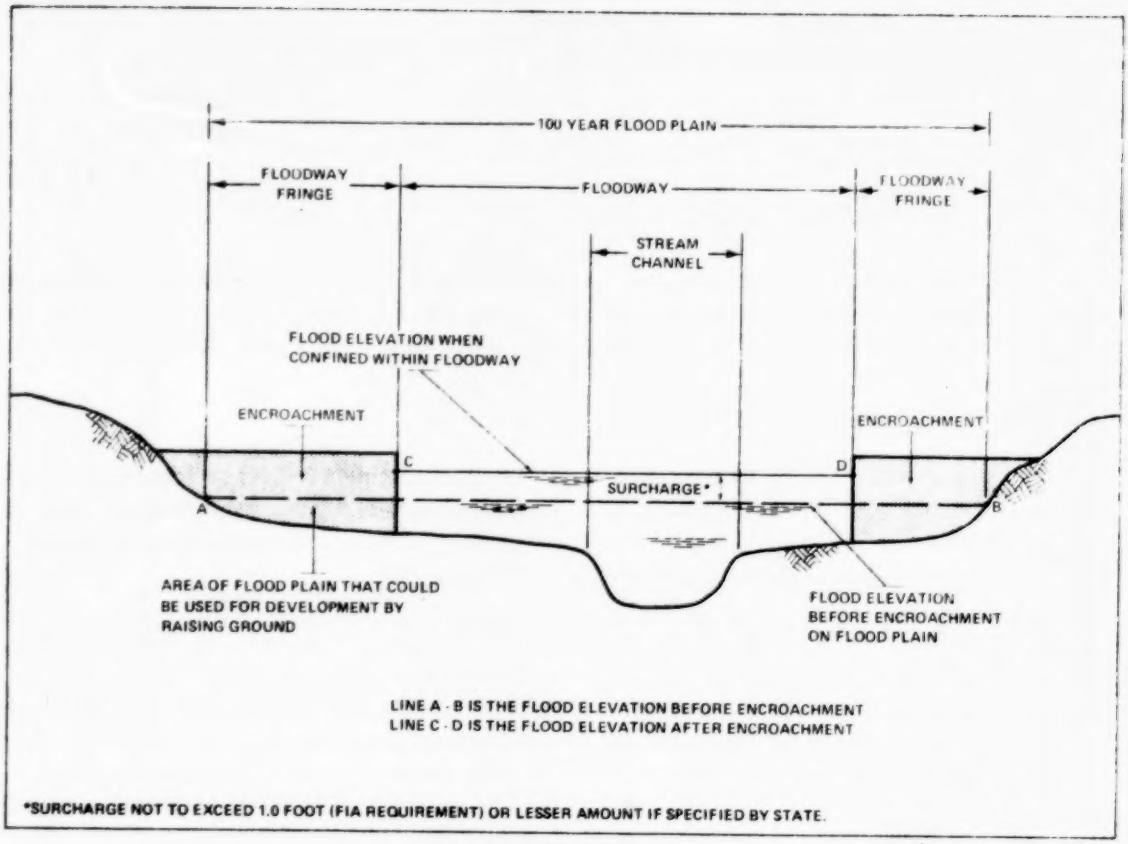
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

FLOODWAY DATA

TENNENTS BROOK AND CROSSWAY CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Borough of Sayreville.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Borough of Sayreville are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Sayreville was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A3 and A9: Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations determined and zone designations assigned according to the FHF.

Zone V9: Special Flood Hazard Areas along coasts inundated by the 100-year flood as determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to FHFs.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Raritan Bay Tidal backwater affecting Raritan River, Cheesequake Creek, Mellins Creek, Tennents Brook, and Crossway Creek	01,02 03,04	-4.7	-1.3	+3.4	045	A9,V9	12
Crossway Creek Reach 1	04	-1.3	-0.5	+1.3	015	A3	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

FLOOD INSURANCE ZONE DATA

RARITAN BAY AND CROSSWAY CREEK

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee or other water-control structure. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of Sayreville is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Contacts with local, regional, state, and federal agencies and a thorough literature search were conducted to determine the availability of existing studies and data relating to discharge analyses and flood elevations in Sayreville.

Reports containing flood elevation data were compared to the results contained in the present study. The findings of this study agree exactly with the results of the Flood Insurance Studies for the Townships of Edison and East Brunswick and the Borough of South River (References 8, 9, and 10). Considering differences in discharges, the water-surface profiles contained in the State of New Jersey Flood Hazard Report Nos. 2 and 8 are also in agreement (References 11 and 12). A storm drainage plan by the Middlesex County Planning Board provided discharge data for the Raritan and South Rivers (Reference 2). The discharges listed at the gage for storms of recurrence intervals of 10 to 30 years are consistent with the results of this study. Also listed are estimated design discharges for the South River which reflect future burdens. As would be expected, these discharges for the same study area are greater than those

calculated here; 12,000 cfs as compared to 7,000 cfs for the base flood. Design discharges for the Raritan River were beyond the scope of study of the storm drainage plan. No other comparative published data pertinent to this study were located.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region II Office, 90 Church Street, Room 801-B, New York, New York.

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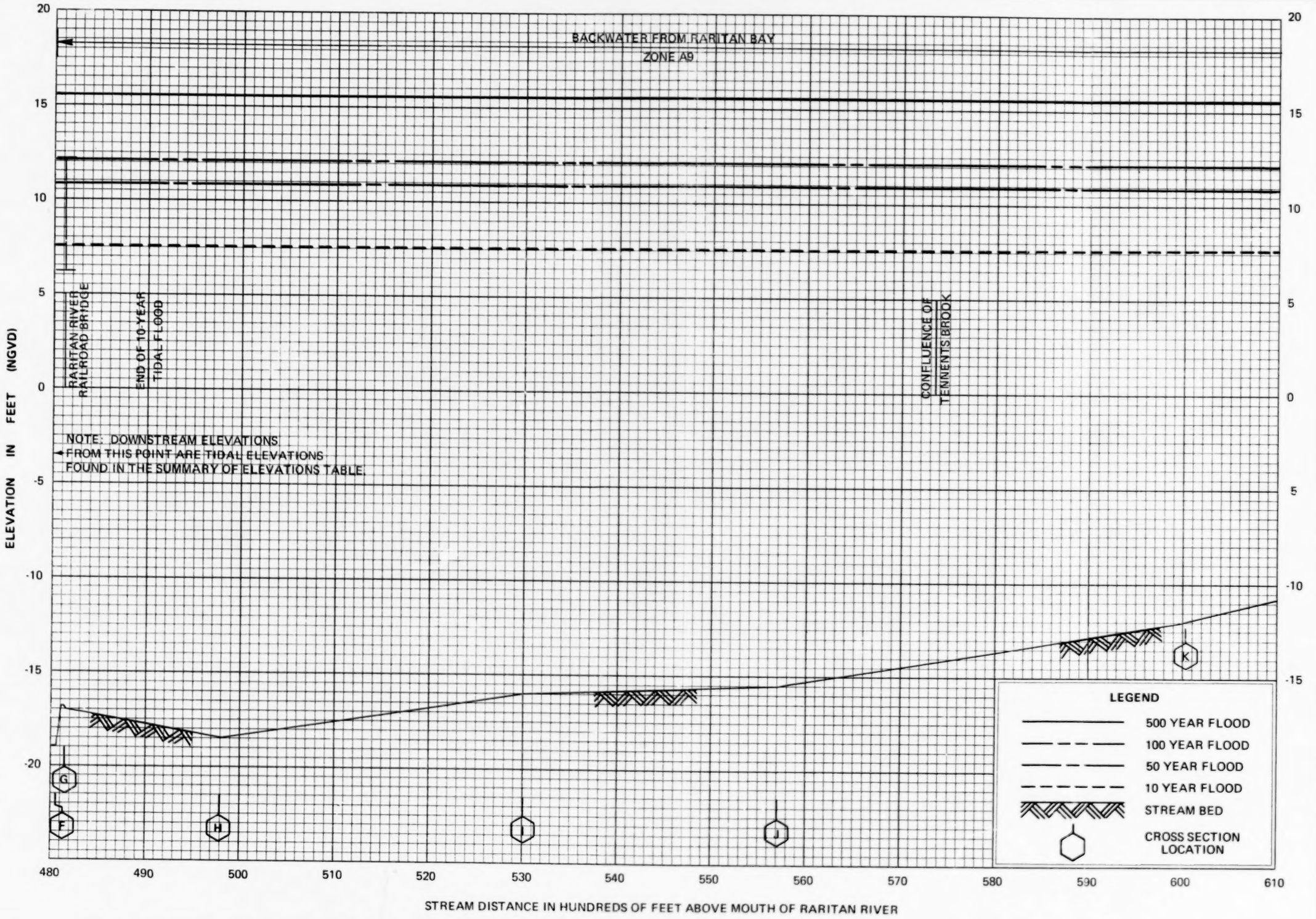
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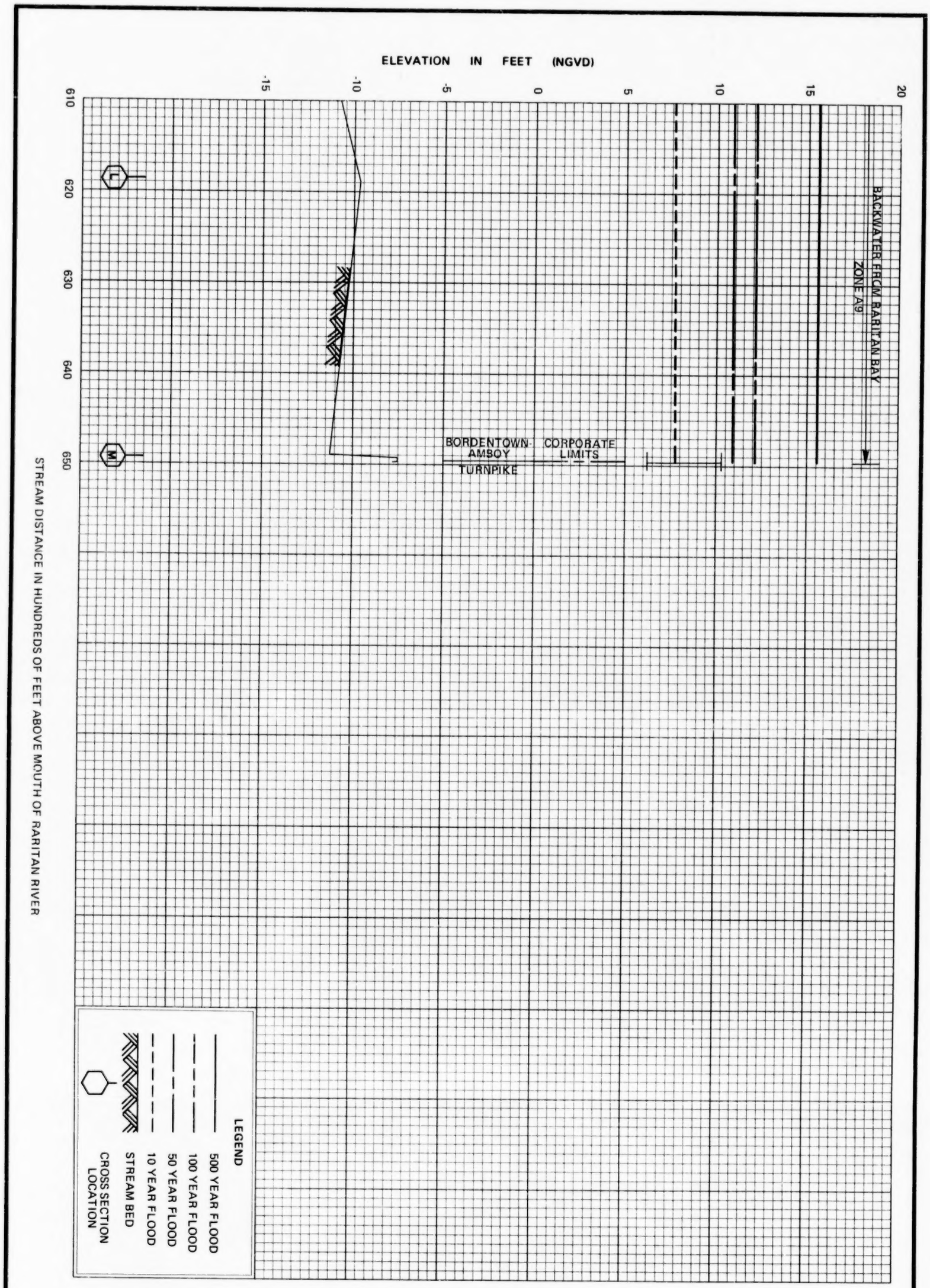
FLOOD PROFILES

SOUTH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

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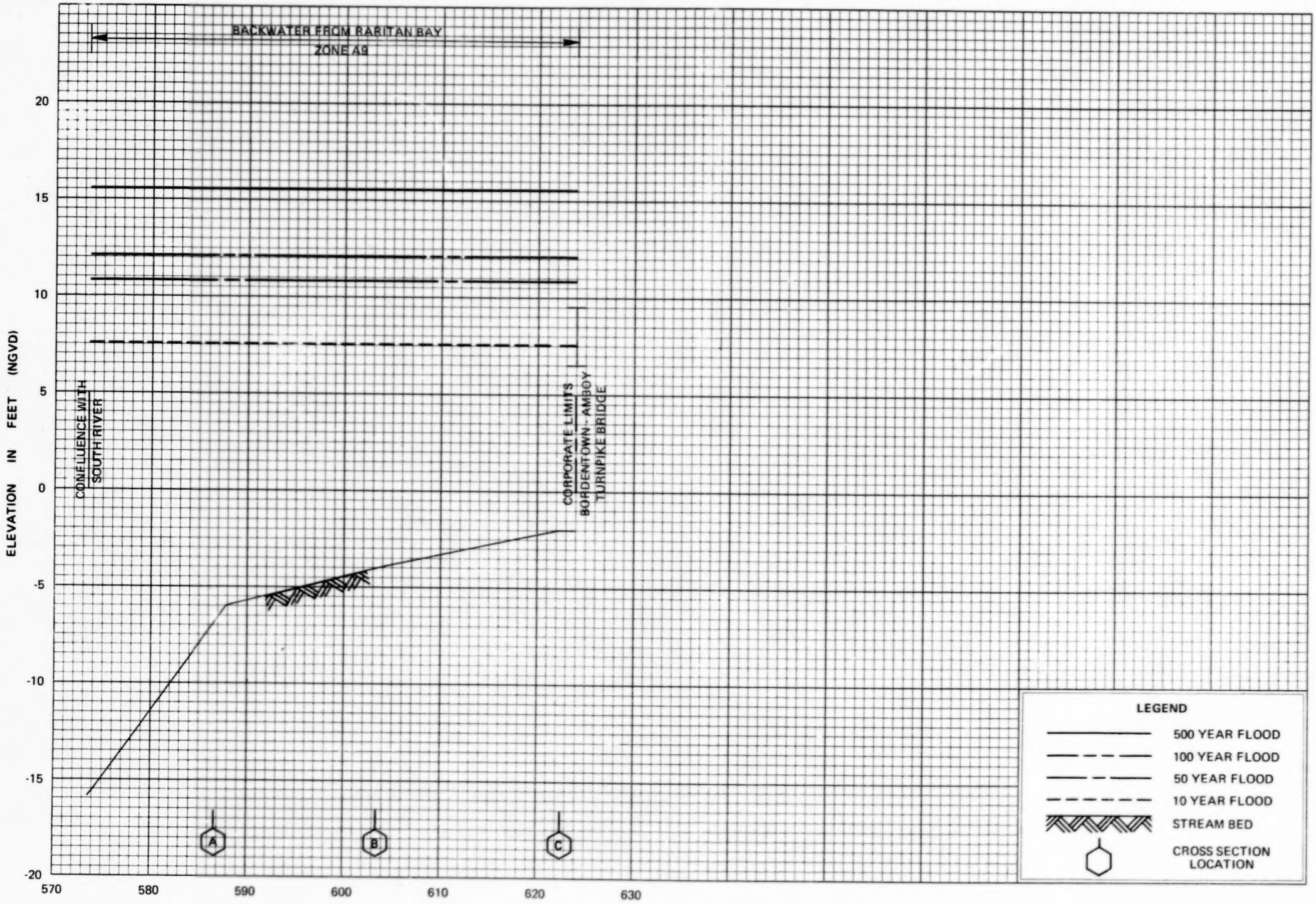
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FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

FLOOD PROFILES

SOUTH RIVER



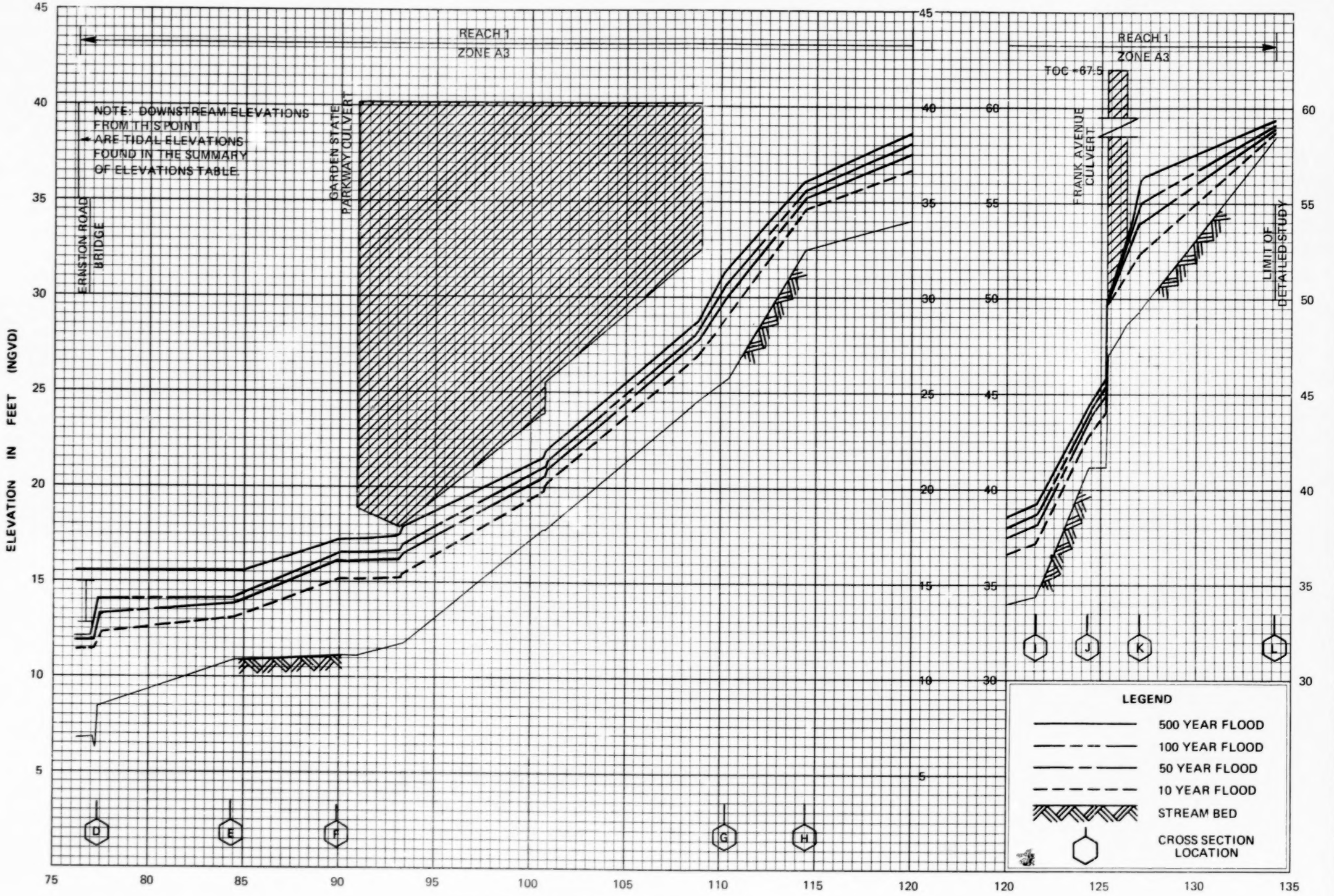
FLOOD PROFILES

TENNENTS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

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FLOOD PROFILES

CROSSWAY CREEK

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BOROUGH OF SAYREVILLE, NJ
(MIDDLESEX CO.)

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